COMMERCIAL AIRWAYS WEATHER SERVICE—PRESENT STATUS AND FUTURE PROSPECTS

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INTRODUCTION

As two and a half years have elapsed since the passage of the air commerce act, it is perhaps timely to review what has been done in that period to make air commerce safe and efficient, and to follow this up with a brief outline of what is proposed for the future.

It was my privilege to talk on this subject at the society's meeting in Philadelphia in December, 1926. Then we had barely started; the service was still in the formative stage. Nevertheless the general character of that service had been determined and a policy for its development had been outlined and adopted. Let us recall briefly the principal features of the service as then set forth. They are:

1. Frequent reports showing current conditions, both surface and upper air.
2. Short-range forecasts giving the outlook for from one to five or six hours, the length of this period depending upon the scheduled duration of any given flight.
3. General weather forecasts for the next 12 to 24 hours.

It is interesting to note that these still remain the dominant features of the service, and that their relative importance is now, as then, that of the order in which they are listed above. Experience has shown, however, that the service must be much more intensive than at first thought, in order that it may contribute its proper share toward safety and efficiency. The organization in the past two years has therefore been in the direction of expansion to cover new airways and intensification along all airways.

THE AIRWAYS AT THE CLOSE OF 1926

At the close of 1926 the transcontinental airway was the only one on which flights were being made both day and night. Not all of it was lighted, but a sufficient part was, to make possible the transportation of mail from one end to the other without stops other than for unloading, loading, and refueling. This was the trunk line of the system. From this there were extensions or branches, for daytime flying only, from New York to Boston; Chicago to St. Louis, Dallas, and the Twin Cities; Cheyenne to Pueblo; Salt Lake City to Pasco and Los Angeles; and San Francisco to Los Angeles and Seattle.

THE AIRWAYS AT THE CLOSE OF 1928

A map (fig. 1) recently issued by the aeronautics branch of the Department of Commerce is illuminating as an index of the expansion that has taken place in the past two years. In the West there is one principal addition, that of the airway between Salt Lake City and Great Falls, and in the Middle West the Chicago-Dallas airway has extensions to Galveston and Laredo, the latter connecting with a Mexican airway to Mexico City.

But it is in the Lake region and in the Eastern States that the largest extension has occurred. There is an intricate network in and south of the Great Lakes region. Atlanta has now become an important center, with through service to Chicago, New York, New Orleans, and Miami. From Miami a line goes to Habana, and shortly this will be extended to the Canal Zone and to Porto Rico. New York has an outlet to the North through an airway that now ends at Montreal and that ties in at Albany with regular service to Syracuse, Buffalo, and Cleveland, where it again joins the trunk line; something like 14,000 miles in all, with about half the distance equipped for night flying, and the plan now is to light some 3,000 miles more during the next year.

In addition there is quite definite talk of two more transcontinental airways—one along the northern and the other along the southern border, with, of course, numerous interconnecting lines, not to mention several offshoots into Canada, Mexico, the West Indies, and eventually to more distant transoceanic countries. As rapidly as possible these are to be lighted and provided with suitable intermediate landing fields, radio, and other aids.

WHAT OF THE WEATHER?

One of the chief aids is weather service. What has been done about it? And what is being planned for the future?

1. *Present status.*—Since 1926, when the air commerce act was passed, service in greater or less detail, depending upon the amount of air traffic, has been organized along all of the commercial airways that have been established or recognized as such by the Department of Commerce. This new service is of course an extension of that already existing for the general public, which consists of twice-daily reports from all parts of the country and forecasts based thereon, these forecasts covering periods of 12 to 36 hours.

Although that service was very early found to be of a too general character to suit the needs of fliers, it did provide the groundwork or parent organization, and as such was capable of expansion at comparatively little additional cost. One of the first acts in making this expansion was to increase the number of what we may call "upper air" stations; that is, those at which observations are made of winds at flying levels. In all, there are now some 50 such stations, well distributed over the country, many of them being located at important points on the airways themselves.

Information regarding upper wind directions and velocities, although helpful in enabling the pilot to select the most favorable flying level, is not vital in the same degree as is similar information concerning conditions at the surface. It is this latter information that determines whether or not any flight at all can be made. Fog, low-lying clouds, excessive rain, sleet or snow, severe thunderstorms, and very poor visibility render flying hazardous and at times impracticable. Not always will this be so, but in the present state of the art it is. Therefore, particular attention is given to these conditions, not only at the upper air stations but also at numerous places where observations are confined to surface weather. In all, there are now approximately 150 stations, most of them on the airways, from which such reports are available when needed. The accompanying map (fig. 2) shows

the distribution of these stations. It will be noted that in addition to the first-order stations, nearly all of which are at important airports, there are numerous secondary or substations, these being placed at fairly frequent intervals. Many of these are at intermediate landing fields. All are selected with reference to the topographic or meteorological conditions which make reports from them valuable and in many cases necessary. For example, such stations are established in regions where fogs are frequent. In one case, two stations are less than 10 miles apart, one being on a high ridge and the other in the lowland. Oftentimes, during bad weather, a landing can be made in one while the other is fogged in. Therefore, reports from both are essential. The reports from these secondary stations are based upon observations made by properly instructed though not technically trained personnel and with a set of instruments for indicating only the more important elements. They are accurate, but not of the high precision required in the general or primary system covering the entire country at 8 a. m. and 8 p. m.

Before each flight a pilot wants answers to the following questions:

(*a*) What is the weather now at the terminal?

(*b*) What is the weather now along the route?

(*c*) Will there be any change during the flight, and if so, what kind of a change?

Answers to these questions require a fast and dependable system of communications and trained meteorologists at the receiving centers. Communications may be called the backbone of the service. It is not for the meteorologist to say what system is best, but he is sure of one thing, namely, that whatever system is adopted it must be under absolute control. The solution appears to be the joint employment of two or more different systems. Just now much attention is being given to the typewriter-printer, or "teletype," for ground communication. Very likely other and perhaps better means will be devised in the future. Final selection will depend upon which system is most prompt, most dependable, and smoothest in operation.

The other requirement, that of close contact with the pilot, is one that the meteorologist must himself provide. The telephone, or any other "distant control" arrangement, will not answer in this case. Experience is conclusive on this point, to the extent in fact that assignment of competent personnel at the more important airports is now the established policy of the Weather Bureau. Here he can see and study the reports "hot off the wire," make his forecasts, and talk the situation over with the pilot.

The reports themselves contain information regarding the general character of the weather, as clear, overcast, rain, snow, etc.; ceiling or height of low clouds; visibility;

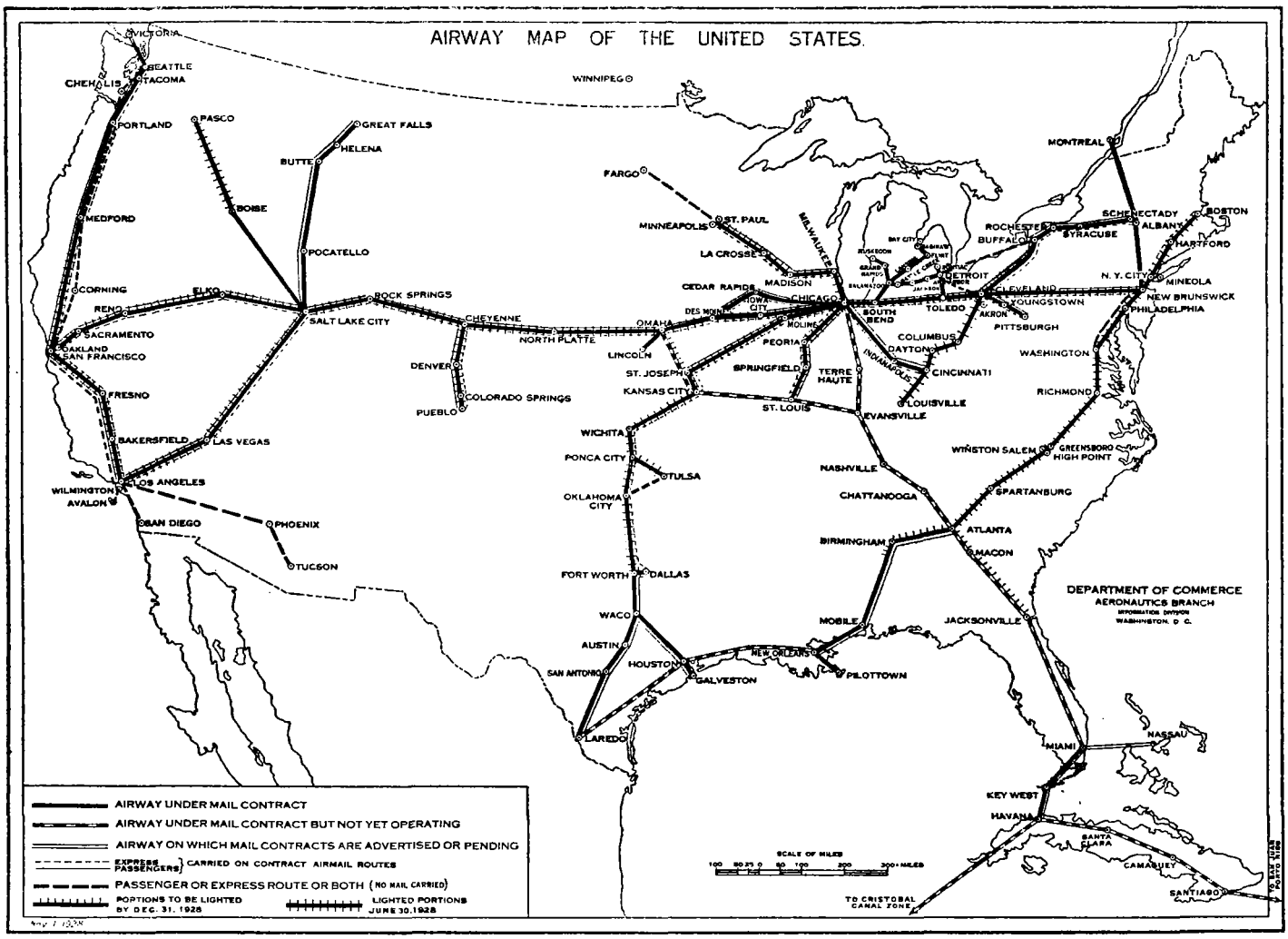

FIGURE 1.—Commercial airways in operation at the close of 1928

wind direction and velocity; temperature and pressure; and when available, upper wind data. They are used by the meteorologist not only in giving out information concerning current conditions, but also as a basis for short-range airways forecasts for the following one to five or six hours. The utility of these short-range forecasts is becoming increasingly evident. It is no exaggeration to say that, in the early days of flying, pilots in general paid comparatively little attention to forecasts unless a very long flight was contemplated. For short trips current reports were deemed sufficient. Many experiences, however, some of them involving considerable hazard and a few of them resulting in accidents, have shown very clearly that a condition reported as existing at any given time may and often does change

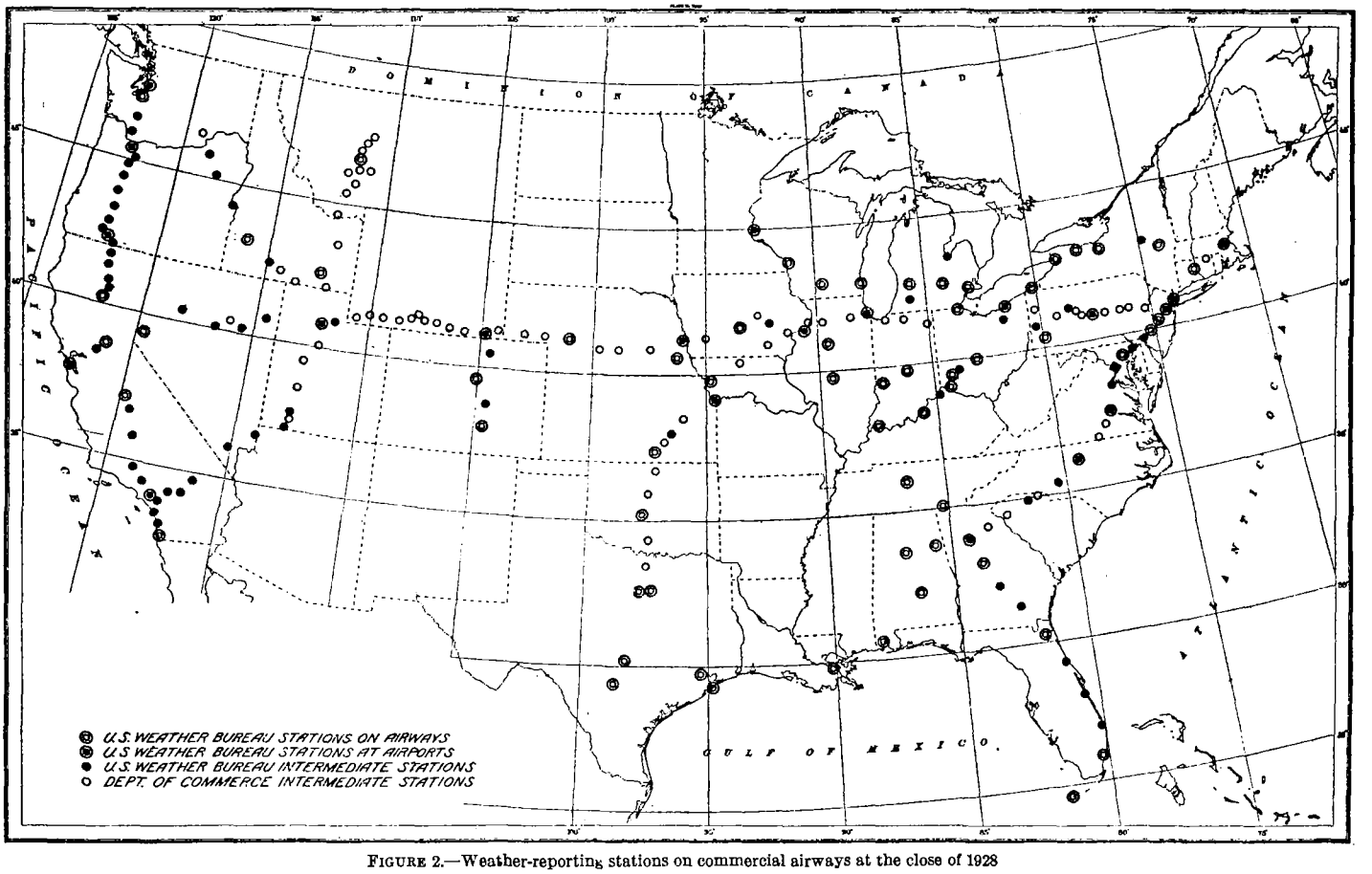

FIGURE 2.—Weather-reporting stations on commercial airways at the close of 1928

decidedly in the course of so short a period as an hour or so. Accordingly, on nearly all airways, the current reports are now supplemented by forecasts of probable changes in existing conditions, with particular reference to type of weather, ceiling, and visibility.

In addition to the current reports and short-range forecasts, the service to civil aeronautics provides forecasts covering periods of 12 to 24 or more hours. These are the general forecasts, augmented to include upper winds. They are of necessity couched in more general terms than are the short-period forecasts. In commercial aeronautics regular schedules must be maintained so far as possible. The operator wants to know to-day the likelihood of making a scheduled flight to-morrow. Particularly is this true in passenger-carrying service. If the probability is that no flight can be made or that there will be considerable delay, the prospective passenger can be so informed and can then, if he so desires, make his trip by train or bus. It seems likely that these longer-period forecasts will become more and more important as the service develops.

Such in brief is the present status of aeronautical meteorology in this country, so far as its practical application in providing current service is concerned. Hand in hand with this development progress is being made on the statistical side, resulting in the publication of data, including wind roses, for hundreds of airports, and landing fields. Meteorological surveys have been and are being conducted locally in and near certain cities with a view to determining the most favorable site for an airport. Just now, through cooperation with one of the air transport companies, recording instruments are being carried on air mail trips for the purpose of investigating the conditions favorable for the formation of ice on aircraft. It is hoped that this investigation will result in making possible more accurate forecasting of such conditions. There are other researches that are under consideration and still others that should be undertaken as rapidly as time and facilities permit.

2. *Future prospects.*—The development of civil flying has been so spectacular and on so large a scale that it is difficult to predict to what lengths it will ultimately proceed. But whatever those may be, certain it is that aids to make it safe and efficient must keep pace with it—must so far as possible be ready for it before the need arises.

During the year now closing two interesting and significant experimental weather and communication services have been inaugurated—one between San Francisco and

Los Angeles, organized by the Daniel Guggenheim Fund for the Promotion of Aeronautics and now operated by the Weather Bureau; the other between Hadley Airport and Cleveland, organized and operated by the Weather Bureau and the Department of Commerce. These two services have many features in common. Both have as their basis of requirement the experience of the past two years which has shown that frequent, regular reports from a close network of stations both on and off the airways are a necessity for safe, and particularly for efficient, operation of airways. From this experience, augmented by the lessons learned in the past few months from the experimental services, there has crystallized a plan of organization toward which it is proposed to work as rapidly as the needs require and facilities permit. The main features of this plan may be briefly outlined.

(*a*) As the fundamental feature there is of course the country-wide (extending beyond this country, in fact) twice-daily system of weather reports, on which are based the weather maps, bulletins, and general forecasts. It is hoped that, in the not distant future, the effectiveness of this system will be very greatly increased by having these reports made four times instead of twice daily as at present.

(*b*) Supplementary reports at 3-hour intervals from comparatively small areas or secondary nets, each area or net covering a section of an airway. These 3-hour reports would of course synchronize with those at 12 or 6 hour intervals. At present the airways service, with some exceptions, gives only occasional reports (timed to fit all scheduled flights) from points on the airways themselves. With the increase of air traffic it has been found that these intermittent reports do not meet the need satisfactorily, and that the absence of reports from points off the airways frequently results in unfavorable weather approaching them from one side or the other with no advance warning. The reports from the secondary nets at 3-hour intervals would enable the meteorologists at airports to follow the development and movement of disturbances approaching the airways from either side and to caution the pilots regarding them. The primary purpose of this 3-hour system of reports is thus seen to be to make possible the preparation and issuance of short-range airways forecasts.

(*c*) Still further supplementing the 12 or 6 hour reports there would be hourly reports of weather and landing conditions from numerous points on the airways themselves. These reports would be broadcast to planes in the air. Unfortunately there are and will always be, at least for a long time to come, many occasions when the weather outlook is decidedly uncertain even to the best trained meteorologist. This is where the value of a ground-to-plane communications system is shown. The pilot starts out perhaps with good weather prevailing and expected, but a fog suddenly develops at his terminal. A radio message tells him so and instructs him either to turn back or to land at some field nearest his terminal where conditions are still good.

(*d*) The need of a prompt and dependable system of communications for collecting the reports at important centers has already been stressed. Commercial telegraph will probably continue to furnish adequate service for the primary network, or the 12-hour reports and later the 6-hour reports. For the secondary nets of

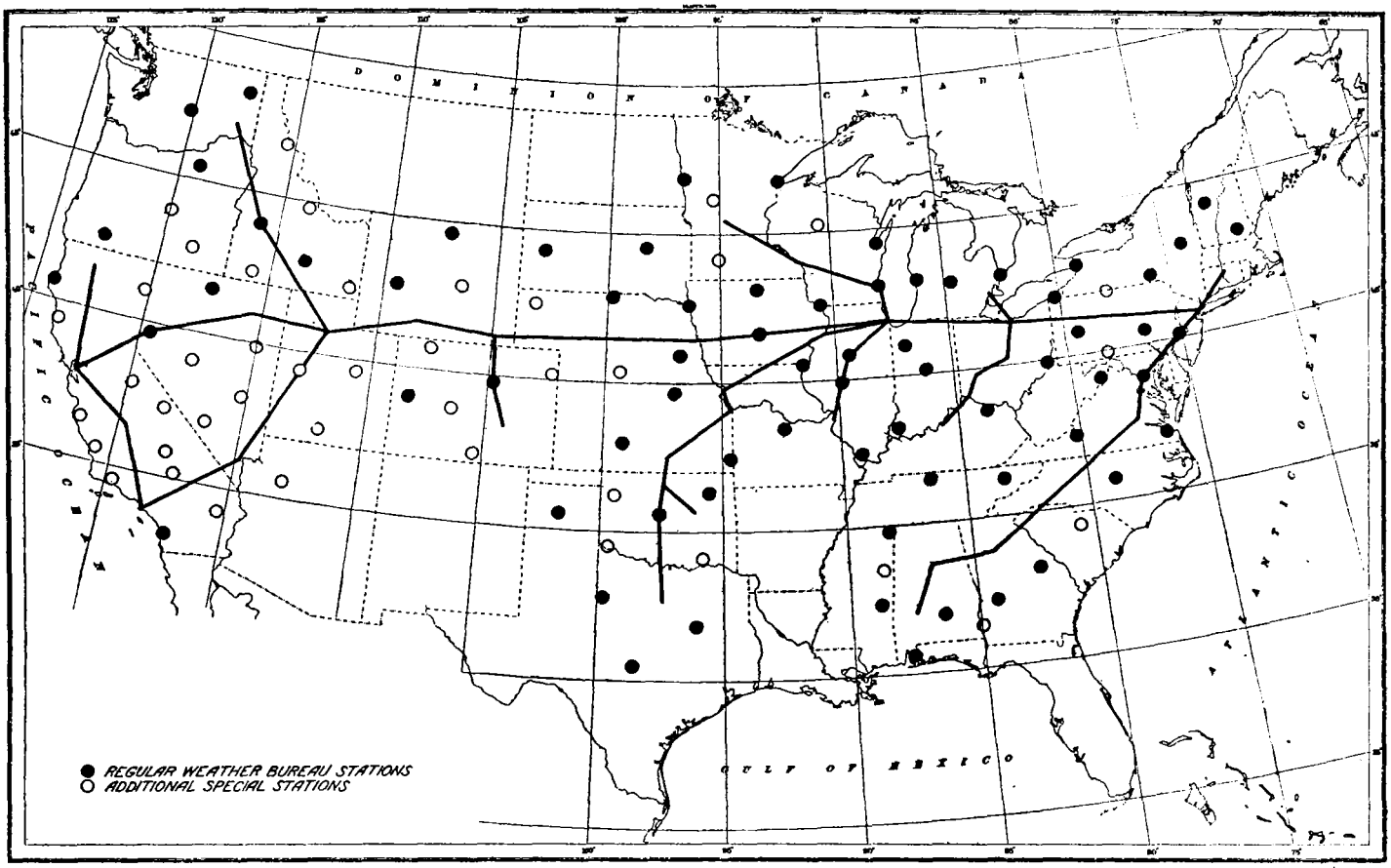

FIGURE 3.—Proposed system of three-hourly reports from off-airway stations ("secondary nets")

3-hour reports from small areas the telegraph will answer in many cases. In others it seems likely that the telephone will have to be used. But for the hourly reports from stations on the airways there must be a communications system that is not subject to use by outside parties; in other words, a leased wire, either telegraph, telephone, or teletype, with all intermediate reporting points tied in with the main or control stations.

Let us consider briefly what this proposed plan for meeting the needs of airways entails in the way of new service. There is already in existence the primary network of stations for the 12 or 6 hour reports. And, as earlier indicated, the airways themselves are quite well provided with intermediate stations for the hourly reports.

It appears that the principal expansion will be required in connection with the 3-hour reports from points off the airways. Attention is called to the accompanying map (fig. 3) on which are indicated the points from or near which it is believed that 3-hour reports should be available for service on the airways that are now equipped for night as well as day flying. Symbols on the map show points at which there are now Weather Bureau stations. Additional personnel would of course be required at these stations. In the case of the other places it would be necessary to appoint special observers.

It will be noted that the points selected are on the average about 100 miles apart in lines more or less parallel to the airways and at a distance from them of about 100 to 200 miles. Many of the stations would serve two or more airways that have a common terminal. Thus, the number of stations required is not in strict ratio to the total mileage. In the proposed set-up 116 stations would serve 7,700 miles of airways, although the average distance between the stations is approximately 100 miles.

The proposed extension will cost considerable money. But so does a passenger plane. So does the operation of a lighting system for night flying. So do airports. The prevention of the crash of one plane filled with passengers, or the increase in efficiency; that is, the increase in arrivals on schedule, by 2 or 3 per cent, would more than justify the cost, which after all would be but an infinitesimal fraction of the total amount involved in commercial aeronautics.

One of the important by-products of intensive service such as that proposed would be its application to all other lines of industrial and commercial activity. People have gotten along with forecasts expressed in general terms, for 12 to 36 hours in advance, because there was nothing else available. These must be continued, of course, as they serve many purposes. But of much greater utility would be forecasts for short periods in advance couched in terms that would naturally be much more definite and precise than are those we now have. Thus anyone asking at 1 p. m. what the weather will be at 3 p. m. would be given a forecast based on reports recently received instead of those in the early morning. As the airways are extended to include all parts of the country, these secondary nets of reporting stations would provide data for relatively precise, short-period forecasts that would vastly increase the utility of weather service not only for the operation of airways but also for all fields of human endeavor.

THE WEATHER OF 1928 IN THE UNITED STATES

By ALFRED J. HENRY

The year 1928 has passed into history with a favorable record so far as the average distribution of temperature and precipitation, the two elements upon which success or failure in crop production greatly depend, are concerned.

Chart 1 shows that the mean annual temperature for the greater part of the country was above the normal, especially in the Plains States from the Dakotas to the Gulf of Mexico.

The numerical values in the form of district average departure from the normal for both temperature and precipitation are given in Tables 1 and 2.

Chart 2 shows that for the United States as a single geographic unit precipitation was close to the normal, some districts, the East Gulf States, the Atlantic seaboard south of New England, the States of Kansas, Missouri, Iowa, Oklahoma, and parts of the surrounding area received greater than the normal rainfall.

Large areas in the Ohio Valley, the West Gulf States, the plateau region west of the Rockies, and the Pacific Coast States received less than the normal.

The weather of the year was conditioned upon the frequency and intensity of extra tropical cyclones and anticyclones which traversed continental United States. The excessive precipitation along the Atlantic seaboard was due to the passage of two tropical cyclones in very nearly the same path. One of these caused great destruction of property and large loss of life in Florida. The number of these barometric formations is given in Table 3.

One hundred and sixty-one tornadoes, great and small, were reported during the year. The Rockford, Ill., tornado of September 14 caused a loss of life of 14 and the injury of 100 persons, this being the greatest casualties in any single storm.